International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017), e-ISSN: 2455-2585
Volume 4, Issue 08, August-2018

EFFECT OF THE NANO SILICA ON THE STRENGTH PROPERTIES AND DURABILITY OF THE STANDARD CONCRETE

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Abstract: Because of quick industrialization and urbanization in the nation part of foundation advancements are occurring .This procedure as thusly lead inquiries to humankind to take care of the issues created by this development. The issues characterized are intense deficiency of development materials, increment the profitability of waste and different items for the most part M40 concrete is utilized for the greater part of the constructional works. Henceforth in this venture M40 concrete is taken and Nano silica powder is utilized. Nano innovation is a developing field of enthusiasm for structural designing application. Among the Nano materials before long used in concrete, Nano-silica have more Pozzolanic nature. It has the capacity to respond with the free lime amid the bond hydration and structures extra C-S-H gel giving quality, impermeability and strength to concrete. Display paper examines the impacts of expansion of Nano silica in ordinary quality cement

The present examination manages halfway substitution of bond by nano silica powder as fractional substitutions in concrete i.e; 0%, 10%, 15%, 20%, 25%. Blocks, Cylinders and pillars were threw and tried at 7, 28, 56 and 90 long stretches of age. The outcomes were contrasted and the aftereffects of solid examples cast with 0% of Nano silica.

Keywords: Nano silica, M40, Compressive Strength , Durability, C-S-H gel, etc,.

I.INTRODUCTION

Concrete is the most generally utilized development material on the planet. Lately, specialists have concentrated on the change of solid quality with respect to its mechanical and solidness properties. These can be accomplished by the use of the supplementary cementations materials. Out of these supplementary cementations materials, silica seethe is the one of the waste materials that is being created in tones of modern waste every year in our nation.

Silica smolder then again, is a fine Pozzolona material. It is a result of delivering silicon metal or ferrosilicon combinations. A standout amongst the most advantageous employments of silica smolder is in concrete. Due to its substance and physical properties; it is an exceptionally responsive pozzolanic material. Concrete containing silica rage has high quality and is extremely solid. As of late Nano Technology has been presented in Civil Engineering applications. A standout amongst the most utilized Nano material is Nano Silica (NS). This is the primary Nano item that has supplanted the smaller scale silica. The progression made by the investigation of cement at Nano scale has demonstrated that Nano silica is greatly improved than silica smolder utilized in traditional cement.

NANO SILICA

Silicon dioxide Nano particles, otherwise called silica nano particles or nano silica, are the reason for a lot of biomedical research because of their dependability, low danger and capacity to be functionalized with a scope of atoms and polymers. Nano-silica particles are partitioned into P-sort and S-type as per their structure. The P-type particles are portrayed by various nano pores having a pore rate of 0.61 ml/g. The S-type particles have a similarly littler surface region. The P-type nano-silica particles show a higher bright reflectivity when contrasted with the S-type. Silicon has a place with Block P, Period 3 while oxygen has a place with Block P, Period 2 of the occasional table

Nano Silica

Applications of Nano silica

The following are the chief applications of silica Nano particles:

[1] As an additive for rubber and plastics.
[2] As a strengthening filler for concrete and other construction composites.
[3] As a stable, non-toxic platform for biomedical applications such as drug delivery and theranostics

Motivation of study

The expanded utilization of concrete is basic in accomplishing a higher compressive quality. Be that as it may, concrete isa real wellspring of contamination. The utilization of Nano materials by replaceme8/nt of an extent of bond can prompt an ascent in the compressive quality of the solid and additionally a check to contamination. Since the utilization of a little extent of Nano SiO2 can influence the properties of cement generally, a legitimate investigation of its microstructure is fundamental in understanding the responses and the impact of the Nano particles. The current papers demonstrate the utilization of admixtures in solid blend. This investigation is an endeavor to clarify the effect of a Nano-silica on the compressive quality of cement by clarifying its properties.

Objective and scope of the study

The main objectives of the present study are as mentioned below:

- To study the effect of Nano-silica on the compressive strength of concrete.
- To study the effect of Nano-silica on workability of concrete.
- To study the behavior of the Nano-silica concrete under split tensile and flexural tests.
- To find the strength of the Nano silica concrete under the acid attack and base attack.
- To find the physical and chemical properties of the Nano silica.

II.LITERATURE REVIEW

Ali Nazari et.al. (2011): He considered quality and rate water ingestion of SCC containingdifferent measure of GGBFS and TiO2nano particles. The discoveries of the experimentation are thatreplacement of Portland bond with up to 45% weight of GGBSF and up to 4% weight of TiO2nano particles gives a significant increment to the compressive, split tractable and flexural strengthof the mixed cement. This expansion is because of increasingly the arrangement of hydrated items inpresence of TiO2; likewise the water penetrability obstruction of solidified cement was moved forward.

The writer additionally considered impact of CuO Nano particles on SCC and watched that expanded level of polycarboxylate admixture content outcomes in diminished pressure quality. The CuOnanoparticles of normal molecule examine 15nm substance with to 4% weight expanded the compressive quality of SCC. CuOnano particles up to 4% could quicken the main crest in conduction calorimetric testing which is identified with the speeding up of arrangement of hydrated concrete items.

J.Comiletti et.al. (2012) This examination researched the impact of small scale and Nano CaCO3 on the early age properties of ultra-elite cement (UHPC) relieved in cool and typical field conditions. The miniaturized scale CaCO3 was added from 0 to 15% b.w.c. what's more, Nano CaCO3 was included at the rate of 0,2.5 and 5% b.w.c. Results demonstrate that by joining Nano and miniaturized scale CaCO3 the stream capacity of UHPC is higher than the control blend which expands the concrete substitution level.

The blend containing 5% Nano CaCO3 and 15% smaller scale CaCO3 gives briefest setting time at 10 °C and at20°C the most noteworthy 24 hrs. compressive quality is accomplished by supplanting bond with 2.5% Nano and5% smaller scale CaCO3 and most elevated compressive quality at 26 days was accomplished at 0% Nano and 2.5%micro CaCO3.

III.MATERIALS

Cement : The standard Portland cement is by a long shot the most vital kind of bond. Preceding 1987, there was just a single review of OPC which was represented by IS 269-1976..

Physical Properties of cement

Sl. No	Characteristics	Values
1	Fineness	5% (should not be more than 10%)
2	Consistency	33%
3	Specific gravity	3.15
4	Initial setting time	30 min.(should not be less than 30 min.)
5	Final setting time	Not more than 10 hours
6	Compressive strength a. 3 days b. 7 days c. 28 days	 Should not be less than 27N/mm^2. Should not be less than 37N/mm^2. Should not be less than 53N/mm^2.

Coarse aggregates

Pulverized stone total of 20mm size is brought from adjacent quarry. Totals of size in excess of 20mm size are isolated by sieving. Tests are conveyed keeping in mind the end goal to discover the qualities of coarse totals. Properties of coarse totals (IS:2386-1963): Specific gravity = 2.98,Fineness modulus = 7.5,Crushing value = 27% (should not be more than 30%),Water adsorption = 0.82%,Bulk density = 1.455gm/cc.

Coarse Aggregate

Fine aggregates

Locally available fresh sand, free from organic matter is used. The result of sieve analysis confirms it to Zone-II (according to IS: 383-1970).The tests conducted and results . Properties of fine aggregates: Specific gravity = 2.30, Fineness modulus = 3.06, Water absorption = 1.20%, Bulk density = 1.657gm/cc.

Fine Aggregates

Nano silica

Silicon dioxide Nano particles, otherwise called silica Nano particles or Nano silica, are the reason for a lot of biomedical research because of their security, low harmfulness and capacity to be functionalized with a scope of atoms and polymers.

Water

By and large consumable water ought to be utilized. This is to guarantee that the water is sensible free from such pollutions as suspended solids, natural issue and broke up salts, which may antagonistically influence the properties of the solid, particularly the setting, solidifying, quality, toughness, pit esteem, and so on. The Ph estimation of water ought not be under 6.

Admixture (super plasticizer)

Conplast SP430 is a chloride free, super plasticizing admixture. To secure functionality of clean Geopolymer Concrete, Sulphonatednaphthalene polymer based absolutely superb plasticizer Conplast SP430 in the state of a dark colored fluid immediately dispersible in water, Use of super plasticizer lets in the markdown of water to the amount up to 30 rate without bringing down the usefulness, in evaluation to the achievable diminishment up to fifteen rate in the event of plasticizers

Mix design M40 grade concrete

Final trial mix for M40 grade concrete is 1:2.29:3.56 at w/c of 0.40

Sl.no	Cement	Coarse aggregates	Fine aggregates	Water	Nano silica
Quantities	206.1kgs	733.3kgs	471.6kgs	85.275liters	26.502kgs
Approximately	206.1kgs	733.3kgs	471.6kgs	87.26liters	26.502kgs
Addition ofextra 10%	226.71kgs	806.63kgs	518.76kgs	95.986liters	29.152kgs

IV.RESULTS AND DISSCUSIONS

1. Test results on the cement

Sl. No	Test	Results	IS code used	Acceptable limit
1	Specific gravity of cement	3.150	IS:2386:1963	3 to 3.2
2	Standard consistency of cement	7mm at 34% w/c	IS:4031:1996	w/c ratio 28%-35%
3	Initial and final setting time	55 mins and 10 hours	IS:4031:1988	Minimum 30mins and should not more than 10 hours
4	Fineness of cement	5.00%	IS:4031:1988	<10%

2. Test results on coarse aggregates

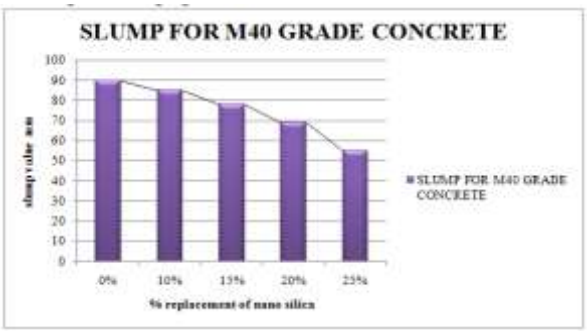
Sl.No	Test	Results	Is code used	Acceptable limit
1	Fineness modulus	7	IS:2386:1963	6.0 to 8.0mm
2	Specific gravity	2.95	IS:2386:1963	2 to 3.1mm
3	Porosity	48.83%	IS:2386:1963	Not greater than 100%
4	Voids ratio	0.8955	IS:2386:1963	Any value
5	Bulk density	1.52g/cc	IS:2386:1963	-
6	Aggregate impact value	39.5	IS:2386:1963	Less than 45%
7	Aggregate crushing value	28.6%	IS:2386:1963	Less than 45%

3. Test results on the fine aggregates

Sl.No	Test	Result	Is code used	Acceptable limits
1	Fineness modulus	3.507	IS:2386:1963	Not more than 3.2 mm
2	Specific gravity	2.68	IS:2386:1963	2.0 to 3.1
3	Porosity	38.6%	IS:2386:1963	Not greater than 100%
4	Voids ratio	0.59	IS:2386:1963	Any value
5	Bulk density	1.95	IS:2386:1963	-
6	Bulking of sand	6.0%	IS:2386:1963	Less than 10%

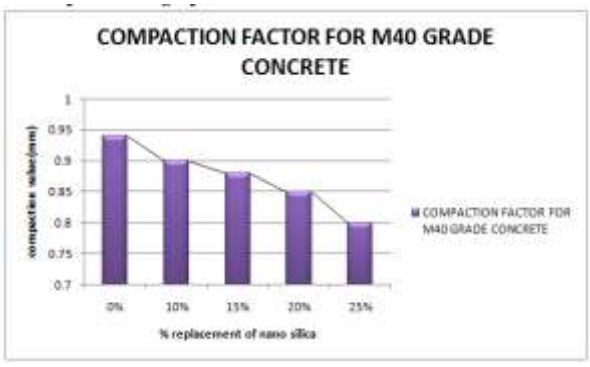
4. Slump values for M40 Grade concrete

S.NO	% Replacement of Nano silica	Slump for M40 grade
1	0%	90
2	10%	85
3	15%	78
4	20%	69
5	25%	55



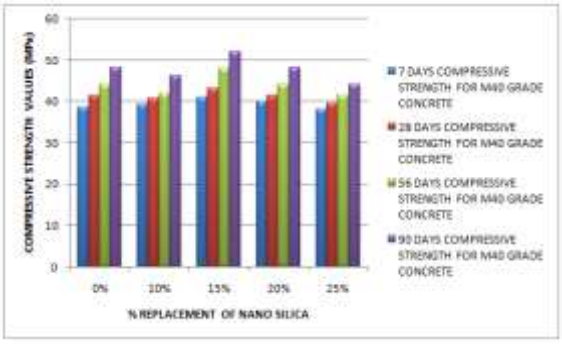
5. Compaction values for Nano silica concrete

S.NO	% Replacement of Nano silica	Compaction factor for M40 grade concrete
1	0%	0.94
2	10%	0.90
3	15%	0.88
4	20%	0.85
5	25%	0.80



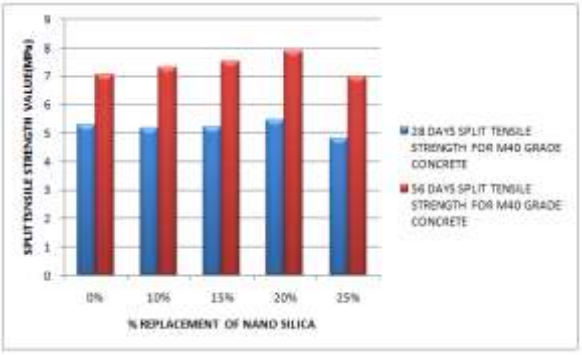
6. Compressive strength

s.no	% replacement of Nano silica	Compressive strength of concrete(MPa)			
		M40 grade concrete			
		7 days	28 days	56 days	90 days
1	0%	38.5	41.37	44.01	48.08
2	10%	39.2	40.64	42.00	46.28
3	15%	40.93	43.1	48.00	52.08
4	20%	40.05	41.40	44.10	48.08
5	25%	38.07	39.50	41.46	44.20



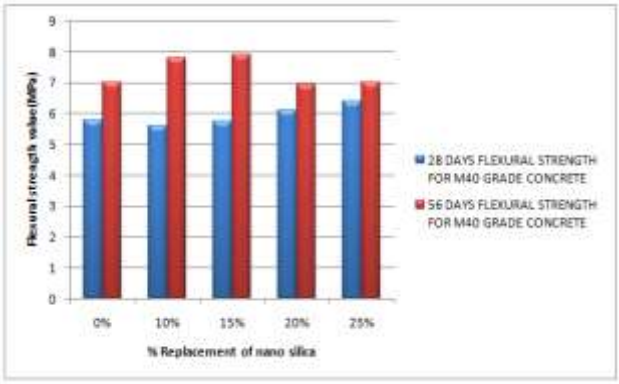
7. Split tensile strength of concrete

Sl.No	% Replacement of Nano silica	28 days split tensile strength for M40 grade(MPa)	56 days split tensile strength for M40 grade(MPa)
1	0%	5.28	7.05
2	10%	5.16	7.29
3	15%	5.20	7.5
4	20%	5.46	7.88
5	25%	4.8	6.98



8. Flexural strength of Nano silica concrete

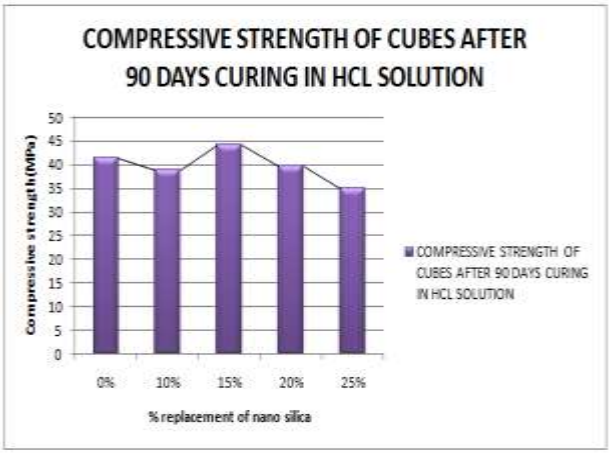
Sl.No	% Replacement of Nano silica	28 days flexural strength for M40 grade concrete(MPa)	56 days flexural strength for M40 grade concrete(MPa)
1	0%	5.8	7.02
2	10%	5.6	7.8
3	15%	6.5	7.9
4	20%	6.1	6.95
5	25%	6.4	7.0



9. Durability test

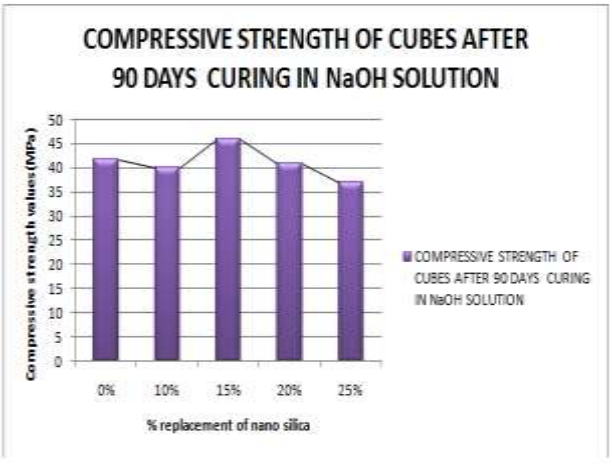
1.Acid attack test:

Sl.No.	% replacement of Nano silica	Initial weight of cube after 28 days curing (grams)	Final weight of cubes after 90 days of curing in grams	% loss of weight due to acid attack	Compressive strength of cubes after 90 days curing
1.	0%	2261	2242	0.82	41.44
2.	10%	2340	2318	0.94	38.88
3.	15%	2351	2323	1.2	44.28
4.	20%	2234	2202	1.44	39.68
5.	25%	2394	2356	1.6	35.00



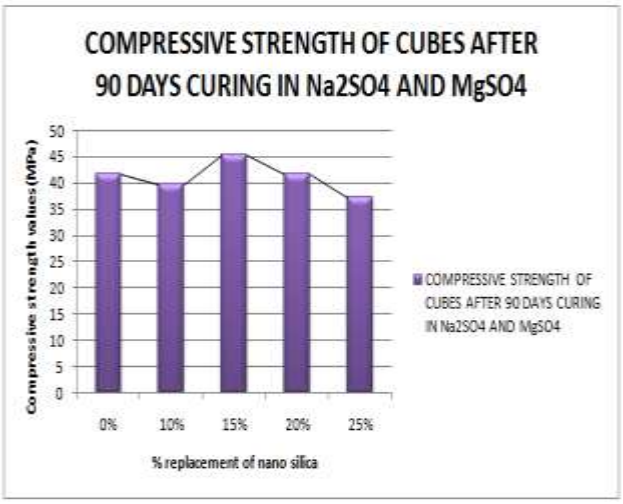
2. Alkaline attack test:

Sl.No.	% replacement of Nano silica	Initial weight of cube after 28 days curing in grams	Final weight of cube after 90 days curing in grams	% loss of weight due to alkaline attack	Compressive strength of cubes after 90 days of curing
1.	0%	2286	2259	1.2	41.85
2.	10%	2340	2306	1.44	40.00
3.	15%	2280	2244	1.6	46.06
4.	20%	2310	2268	1.84	40.98
5.	25%	2296	2251	1.96	36.90



3. Sulphate attack test

Sl.No.	% replacement of Nano silica	Compressive strength of cube after 90 days curing
1.	0%	41.78
2.	10%	39.79
3.	15%	45.38
4.	20%	41.78
5.	25%	37.40



V. CONCLUSIONS

From the above experimental program the following conclusions are made

1. The material properties of the cement, fine aggregates and coarse aggregates are within the acceptable limits as per IS code recommendations so we will use the materials for research.
2. Slump cone value for the Nano silica concrete decreases with increasing in the percentage of Nano silica so the concrete was workable up to 15 %.
3. Compaction factor value of Nano silica concrete decreases with increase in the percentage of Nano silica.
4. The result of compressive strength of concrete is maximum at 15% replacement of Nano silica due to excess silica leads to shrinkage of concrete. If silica replacement is low i.e lower than 15% of replacement of nano silica leads to less bonding of concrete.
5. The compressive strength of concrete is the optimum value for 7days curing and 28days curing.
6. Split tensile strength for the cylindrical specimens is maximum at 20% of replacement of Nano silica for 28days curing.
7. The flexural strength of Nano silica concrete is also maximum at 25% replacement of Nano silica for 28 days of curing.
8. In durability test, the nano silica concrete containing 15% of nano silica exhibits better resistance against acid attack, alkaline attack and sulphate stack test for 90 days of curing.
9. The durability of concrete result shows higher resistance in alkaline test compared to acid test and sulphate attack test. So the replacement of 15% to 25% of nano silica is generally useful for better strength values in M40 grade of concrete.

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